

900 SEWERAGE WORK

ITEM 908 - TUNNEL

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908.01 Description. This work shall consist of the construction of a tunnel and pipe sewer. The work shall include the excavation, removal of water, furnishing and installing a tunnel liner of sufficient size to accommodate the placement of the sewer and fill material, grouting, the placement of a paved tunnel liner invert or sewer pipe support structure, the laying of the sewer pipe and the construction of the tunnel end bulkheads as shown on the plans and specified herein. Where conditions warrant, Item 909 may be substituted when approved by the Engineer.

908.02 Materials. Materials shall be as follows:

1.	Tunnel liner	908.06
2.	Cement for grout	701
3.	Sand for grout	703.03
4.	Concrete, Class A.....	499, 905
5.	Pipe sewer	901.02
6.	Controlled density fill mixes, cementitious material for fill.....	636, 912.02

908.03 General. Tunneling within the right-of-way of private companies and public agencies shall conform to the requirements and regulations of the respective companies or agencies. Before proceeding with the tunneling work, the Contractor shall prepare and submit to the Engineer, for his approval, the necessary working schedule, a description of the type of materials to be used and the methods of construction to be utilized. *The Contractor is required to submit shop drawings, accompanied by calculations, and stamped by a Professional Engineer registered in the State of Ohio, showing the adequacy of the liner materials and shield, if utilized. The Contractor shall furnish 6 copies of the shop drawings and all copies will be forwarded by the Engineer to*

the authority involved for its approval. One approved copy will be returned to the Contractor. The Contractor shall be responsible for the payment of any costs which may result due to the authority's requirements, of whatever nature, including the furnishing of watchmen and supervision by its forces.

Where work under this item involves the tunneling under of railroad tracks, all operations of the Contractor or his agents and employees must be subordinate to the free and unobstructed use and conduct of the railroad company's business without delay or danger to life, equipment or property. The Contractor shall save harmless the railroad company against all claims, suits or judgments arising because of or resulting from the operations, actions or omissions of the Contractor or his agents and employees. The Contractor shall carry on his operations in such a manner that all work shall be performed below track level and without obstructions on the railroad roadbed.

908.04 Construction Layout and Alignment Holes. The City will locate and reference the centerline of the project. The Contractor shall protect and be responsible for any required replacement of control points set by the City. The Contractor shall use competent personnel and suitable equipment for the layout work required and work shall be performed under the supervision of a Registered Professional Engineer or a Registered Surveyor. Field notes of all layout work shall be submitted to the City of Columbus.

If a tunnel is greater than 400 feet (122 m) in length, alignment holes will be required, *unless otherwise directed by the Engineer*. Alignment holes shall be drilled at a maximum of 400 feet (122 m) apart along the centerline. Additional alignment holes may be required if it is determined that the tunnel is not on line and grade within the limits specified. The holes shall be drilled to such depth as is necessary for the casing to extend into the tunnel excavation. A casing of adequate size and strength, 6 inch (152 mm) minimum, shall line the hole and shall be set vertically.

Where a hole is located in the existing pavement, the pavement shall be cut where the hole is to be drilled. After the casing is in place, a suitable, substantial cover shall be inserted in the casing at street grade, and the space outside the casing filled with concrete.

Following completion of the tunnel liner the alignment holes may be utilized for grouting voids. Upon completion of the pipe installation and grouting the alignment holes shall be filled with controlled density fill material Item 636.

908.05 Tunnel Shield. A tunneling shield is recommended for all liner plate installations and shall be used on all railroad installations.

The shield if required shall be of steel construction and designed to support the loading from the installation. The advancing face shall be provided with a hood or an approved grid system, shall have sufficient length to install 1 complete ring of liner plates or one set of ribs and lagging within the shield before advancing, and shall not exceed the

outside dimensions of the tunnel liner plate installation by more than 1 inch at any point on the periphery.

The shield shall be adequately braced and also provided with appurtenances for completely bulkheading the face (details to be submitted with the design information).

908.06 Tunnel Lining. The tunnel *liner* installed by the Contractor shall provide strength commensurate with the tunnel diameter and depth of cover and in accordance with the design requirements of the private or public authority involved. The Contractor, prior to initiating construction, shall provide the liner details, reasons for selecting the liner supports and materials and calculations demonstrating the adequacy of the method of tunnel *liner* support.

If ribs and lagging are used for tunnel lining, a rib expander shall be used to expand the rib outward and upward by a continuous contact between the rib expander and the rib.

Tunnel liner plates shall be a minimum of 12 gage, hot rolled, structural quality carbon steel plates conforming to ASTM A-569. *Each ring shall be offset by rotating the starting plate, so that end flanges of the adjacent rings do not fall in line.*

908.07 Excavation. The Contractor shall excavate all material of whatever nature encountered, including rock, necessary for the construction of the work. All excavated material shall be considered unclassified material. Excavation shall not be advanced beyond the edge of the shield, except in rock.

908.08 Soil Stabilization. Pressure grouting of the soils or freezing of the soils before jacking, boring, or tunneling may be required at the direction of the Engineer to stabilize the soils, control water, prevent loss of material and prevent settlement or displacement of embankment. Grout shall be cement, chemical or other special injection material selected to accomplish the necessary stabilization.

The materials to be used and the method of injection shall be prepared by a Registered Professional Soils Engineer, or by an experienced and qualified company specializing in this work and submitted for approval to the Engineer before the start of work. Proof of experience and competency shall accompany the submission. *If Soil Stabilization is required by the changed conditions as described in 104.02, the City will pay for this work according to 104.03.*

908.09 Dewatering. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site. When dewatering, close observation shall be maintained to detect any settlement or displacement of railroad embankment, tracks, pavement and other facilities.

908.10 Grouting. Grouting shall be kept as close to the heading as possible, using grout stops behind the liner plates, if necessary. Grout holes shall be provided in the

tunnel lining with a spacing not to exceed 4.5 feet (1.4 m) measured longitudinally. The location of holes shall be varied around the periphery of the tunnel lining to suit field conditions which will permit the proper grouting sequence to insure complete filling of void spaces outside the tunnel lining (initial spacing recommended at 3 feet (0.9 m)). The Contractor shall fill all the void space outside the tunnel lining caused by the tunneling with 1:3 (cement:sand) cement grout. Grouting shall be performed when ordered by the Engineer, but in no event shall more than 6 lineal feet (1.8 m) of tunnel be progressed beyond the grouting without prior written approval of the Engineer. All completed sections shall be grouted if work is suspended for more than 24 hours. The grouting shall start at the lowest hole in each grout panel and proceed upward simultaneously on alternating sides of the pipe. A threaded plug shall be installed in each grout hole when the grouting is completed at that location. *The face of the tunnel shall be bulkheaded by approved methods whenever the job is vacated or when directed by the Engineer.*

The machine used for grouting shall permit the application of a pressure up to 75 pounds per square inch (517 kPa) in excess of any external water pressure. A gauge shall be provided which will accurately indicate working pressure and this gauge shall be carefully watched during grouting operations. The pressure shall at no time be allowed to exceed that considered safe, which would distort the tunnel lining or which would be adequate to lift and/or displace the overburden. Grout pipes shall be a minimum of 1 1/2 inches (38 mm) inside diameter. In freezing temperatures, means shall be employed to heat mixing water for grout and proper insulation shall be provided to prevent freezing grout in grout tubes from point of initial discharge to final position of grout in place.

908.11 Fill Material. After installation of the sewer in the tunnel lining, the Contractor shall completely fill the space between the tunnel liner and the sewer with 1 to 5 Portland Cement grout, or Class A concrete, or Item 636 Controlled density fill mixes.

908.12 Method of Measurement. The length of tunnel and appurtenances to be paid for will be the actual number of linear feet (meters) accepted, as measured along the centerline of the sewer, complete in place. When the tunnel shaft is included in the tunnel unit prices, measurement will be from the center of the tunnel shaft.

908.13 Basis of Payment. The accepted number of linear feet (meters) of tunnel for the pipe sizes specified will be paid for at the contract unit prices per linear foot (meter) complete in place. The cost of the tunnel shaft shall be included within the unit price bid for the tunnel unless a separate bid item for Tunnel Shaft (920) is included in the line items. If the shaft is included with the tunnel unit prices payment will be made from the center of the shaft to the end of the tunnel. If a separate bid item for Tunnel Shaft (920) is included, the tunnel will be paid commencing 1.33 feet (0.4 m) inside the outside wall of the shaft.

Payment for the encased sewer pipe will be made under Item 901.

Payment will be made under:

Item	Unit	Description
908	Linear Foot (Meter)	Tunnel for ____ Inch (mm) Diameter Pipe, Including Shaft
908	Linear Foot (Meter)	Tunnel for ____ Inch (mm) Diameter Pipe, Excluding Shaft